DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, Secretary

UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, Director

BULLETIN 690—D

QUICKSILVER DEPOSITS OF THE PHOENIX MOUNTAINS ARIZONA

BY

FRANK C. SCHRADER

Contributions to economic geology, 1918, Part 1
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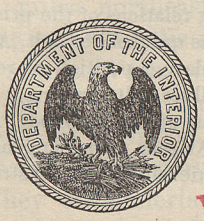

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QUICKSILVER DEPOSITS OF THE PHOENIX MOUNTAINS, ARIZONA.

By Frank C. Schrader.

FIELD WORK AND ACKNOWLEDGMENTS.

This report is based on a two days' field examination made in March, 1917, chiefly in company with the owners of the several properties. For valuable information and courtesies generously extended the writer is indebted to the owners and operators, especially to Messrs. J. A. Porterie, Samuel Hughes, Louis Larsen, L. L. Brunson, E. L. Ish, B. Jones, and E. Husted; also to Dr. Burt Ogburn, Mr. Fred Holmquist, and the Phoenix Chamber of Commerce. Some of the mineralogic determinations were made by E. S. Larsen and Chase Palmer, of the United States Geological Survey.

GEOGRAPHY.

The Phoenix Mountains constitute an outlying desert range of the Great Basin type in Maricopa County, south-central Arizona (fig. 8). The range is on the border between the mountainous region on the northeast and the desert region on the southwest and is about 25 miles long by 5 miles wide. Beginning with Camelsback Mountain, a noted landmark in the big bend of the Arizona Canal near Scottsdale, about 7 miles northeast of Phoenix, it extends north-northwestward to the mountainous region beyond Cave Creek station. It lies between Paradise Valley on the east and Agua Fria Valley on the west, both of which drain southward into the Salt River valley. These valleys are all broad, flat-bottomed depressions and connect with the general desert plain forming the surface of southwestern Arizona. They are underlain by unconsolidated rock débris or valley fill, accumulated from the surrounding mountains. The southeast end of the range lies in the southwest corner of the Camelsback quadrangle as mapped by the United States Geological Survey.

According to Meinzer and Ellis,[1] the Phoenix Mountains—

rise abruptly from the valley floor to heights of 1,200 to 1,500 feet but reach elevations of only 2,000 to 3,000 feet above sea level. So much of the range has been buried by the sediments washed from the mountainous areas north and east of Paradise Valley that its low gaps no longer stand above the general level of the valley fill. Hence the range is no longer an effective drainage divide but is at present crossed by the channel of Cave Creek.

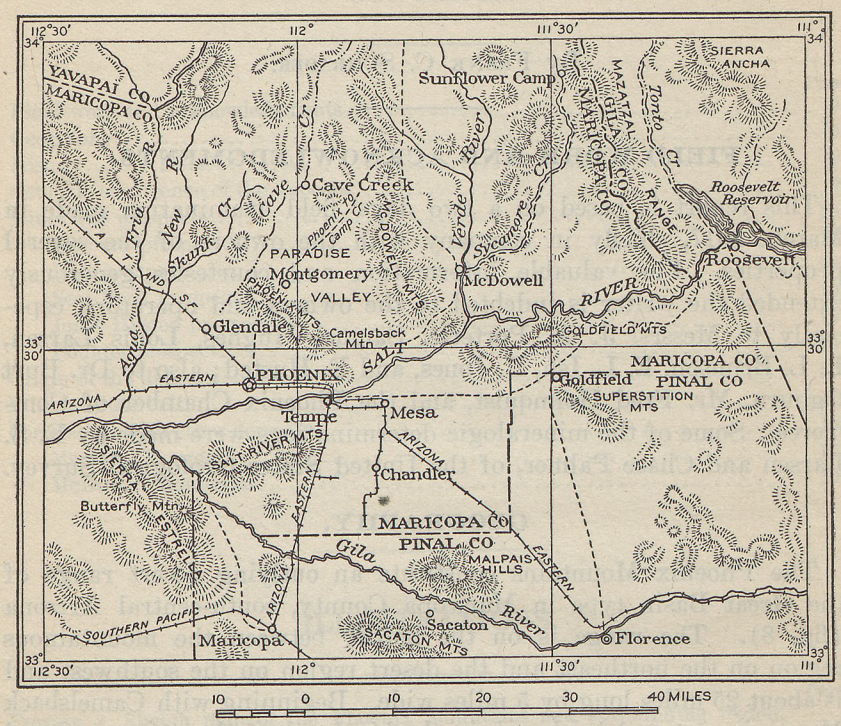

FIGURE 8.—Sketch map of the Phoenix Mountains and surrounding region, central Arizona.

Cave Creek has been diverted from the Paradise Valley drainage by the valley fill. As a result of this diversion certain of the passes have migrated far to the east of the central axis, particularly in the southern part of the range. From a point near Scottsdale the Arizona Canal follows the southwest base of the range for about 12 miles. The range is composed of igneous and metamorphosed sedimentary rocks, including granites, gneisses, schists, slates, and quartzites, which are tilted at high angles and have a prevailing southeastward dip.[1] They are mostly pre-Cambrian. In the north-middle part of the range just north of Cave Creek station there are several hills consisting of vesicular basalt. According to Lee,[2] the pre-Cambrian

[1] Meinzer, O. E., and Ellis, A. J., Ground water in Paradise Valley, Ariz.: U. S. Geol. Survey Water-Supply Paper 375, pp. 54–55, 1915.

[2] Lee, W. T., Underground waters of Salt River valley, Ariz.: U. S. Geol. Survey Water-Supply Paper 136, p. 96, 1905.

metamorphic sedimentary rocks, quartzites, and argillites are many thousand feet in thickness.

The quicksilver deposits here described are in the southern part of the range, in the Winifred mining district, about 10 miles northeast of Phoenix and about the same distance east of Glendale, the nearest railway stations. They occur along a belt about 3 miles wide that extends north-northeastward across the range and contains in its southern part Squaw Peak, a prominent landmark rising to an elevation of about 2,500 feet. Most of the deposits are in the southwest slope of the range, at elevations between 1,200 and 1,800 feet, and lie in or near low passes or washes traversed by good roads that connect with paved highways extending almost to the base of the range. They may also be reached from the Phoenix-Glendale Electric Railway by a walk of 3 to 5 miles. Other conditions are favorable to mining operations. Near by is the rich agricultural region of Salt River valley, where grain, fodder, vegetables, produce, and fruits are produced in abundance. From October to May the climate is admirable, and during the rest of the year it is less torrid than that in the Gila and Salt River valleys generally. Paradise Valley contains excellent underground water. In the Montgomery well, which ends in valley fill at a depth of 225 feet, water was encountered at 196 feet. Limestone presumably suitable for flux and lime is plentiful in the area. The present exceptional demand for quicksilver in the manufacture of fulminate makes the deposits of particular interest.

HISTORY.

Old monuments indicate that ground was staked for mineral in this area perhaps 40 or 50 years ago. Prior to the present discovery of quicksilver, however, no mining and little prospecting was done.

Quicksilver was discovered here by L. L. Brunson, of Phoenix, in March, 1916. Several years earlier Mr. Brunson had observed boulders and fragments of a fibrous rock stained green, reddish, and brown by copper and iron minerals and found the source to be the cropping of an extensive 8-foot vein at what is now Discovery No. 1 claim of the Seal Rock group, on the southwest slope of Squaw Peak (fig. 9). He was much surprised to learn that the prospect promised to be of value for its content of quicksilver rather than of copper, as the presence of quicksilver had not been suspected in the Phoenix Mountains.

The next notable discovery was the quicksilver deposit situated by the roadside in the northeastern part of the area (fig. 9). It was found about November 1, 1916, by Henry Porterie and his father, J. A. Porterie, of Phoenix. The deposit was soon opened by a shallow shaft, and the Mercury and Constellation groups of claims were staked along the lode.

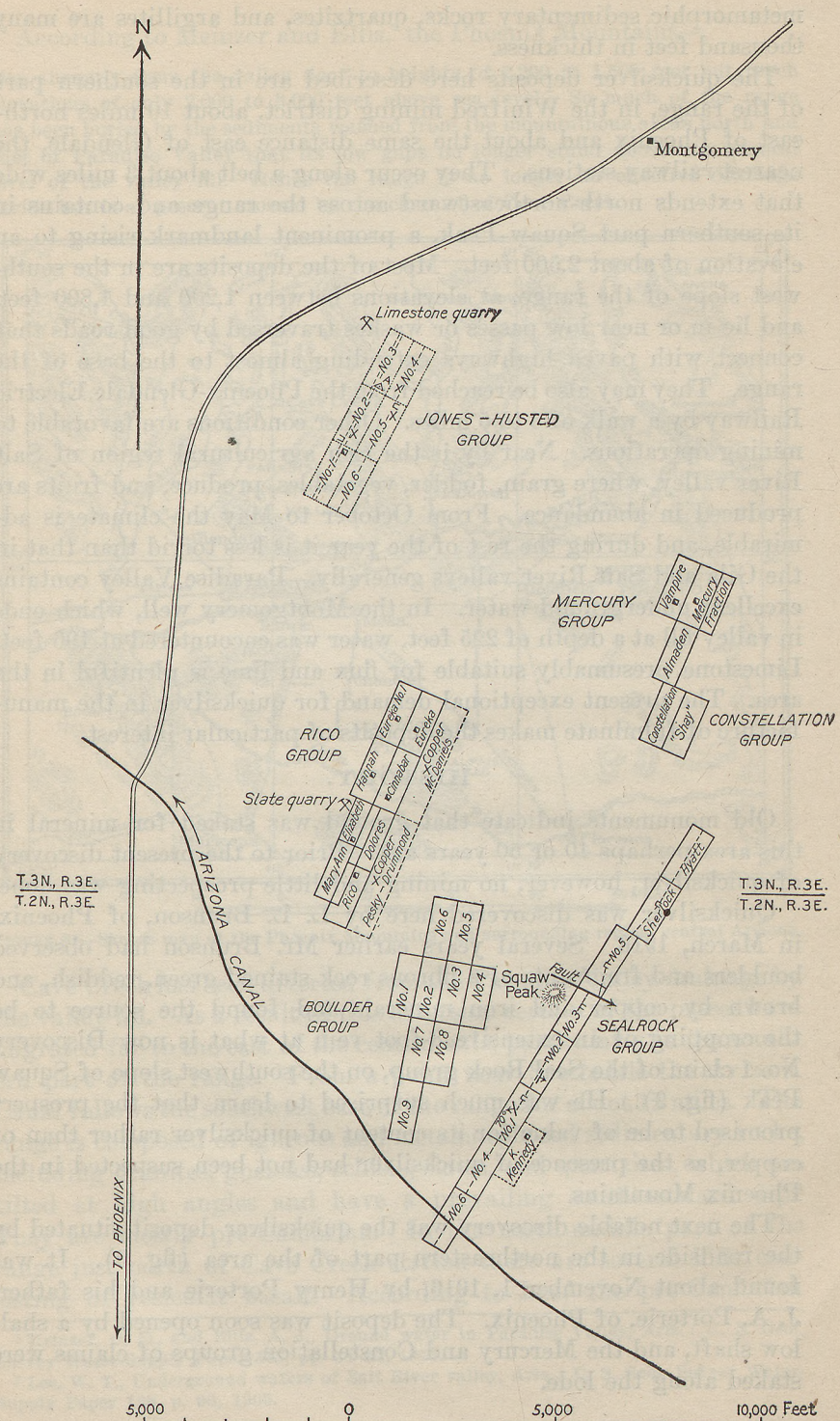

FIGURE 9.—Sketch plan showing relations of the principal claim groups in the Phoenix Mountains quicksilver belt, Arizona.

The Mercury group is owned by the Porteries, and the Constellation group by James Shay.

The remaining important deposit is that of the Rico prospect, near the middle of the area, on the road and in and near Rico Wash, on open ground (fig. 9). It was discovered on December 18, 1916, by Samuel Hughes, who with his partners, Louis Larsen and F. E. Jetter, own and work it.

Since the discovery of quicksilver several copper prospects have also been found. Of these the more valuable are the Pesky-Drummond and McDaniels, which seem to be on a lode that parallels the Rico lode. The claims join those of the Rico group on the east, as shown in figure 9. The Pesky-Drummond prospect is 525 feet east of the Rico prospect. The surface copper ore contains considerable chalcocite, chalcopyrite, and malachite, and a little chrysocolla and quicksilver.

GEOLOGIC OCCURRENCE OF THE DEPOSITS.

The rocks of the area are metamorphosed sediments of pre-Cambrian age. They consist chiefly of quartz schist, sericite schist, slate, argillite, limestone, quartzite, kyanite schist, and jasper and

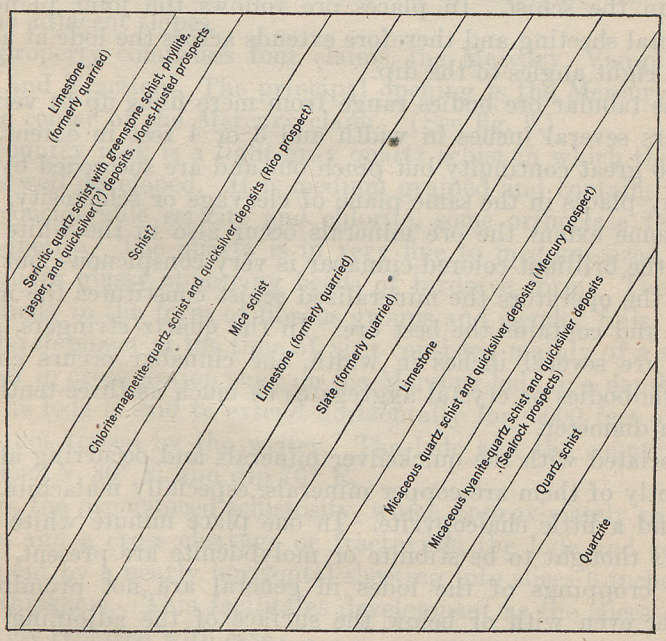

FIGURE 10.—Diagram showing relative position of rock zones in the Phoenix Mountains quicksilver belt, Arizona.

crop out in belts or zones trending north-northeastward diagonally across the range (fig. 10). They dip steeply to the southeast and are cut by cross faults.

The quicksilver deposits occur in two or more of the schist belts, in zones of shearing or fracture that parallel the lamination in the inclosing schist. These zones trend approximately N. 30° E. and stand nearly vertical. They range from 5 to 40 feet or more in width, though generally without definite walls, and some have a known length of more than a mile. The deposits consist mainly of portions of the country rock which have been more than normally crushed and made schistose and later mineralized. They contain numerous specks, veinlets, films, small bodies, and crystals of cinnabar and metacinnabarite, the black secondary sulphide of mercury. A few globules of native quicksilver associated with the cinnabar ore have been reported from the Rico prospect.

The gangue minerals, the chief constituents of certain stringers and veinlets, are quartz, calcite, hematite, and limonite. Kyanite and tourmaline are locally abundant in the ore but are probably residual constituents of the replaced wall rock. The ore minerals seem to have been formed chiefly through impregnation but also through metasomatic replacement in the schist, and they favor the hanging-wall sides of the lodes.

The ore bodies occur in large measure along the planes of schistosity in the schist. In places ore follows the joint planes of a horizontal sheeting and therefore extends across the lode at approximately right angles to the dip.

These tabular ore bodies range from mere films up to veinlets or stringers several inches in width and 3 or 4 feet in extent. They have no great continuity but pinch out and are succeeded by others, at many places in the same plane of cleavage or schistosity.

To some extent the ore minerals occur also in the white quartz, where the brilliant-colored cinnabar is very conspicuous, but according to the operators the mineralized schist constitutes the main ore bodies and contains the best ore. In the quartz stringers, some of which are several inches in width, the cinnabar occurs chiefly as sporadic bodies or crystal aggregates as much as three-tenths of an inch in diameter.

Associated with the quicksilver minerals and occurring also independently of them are copper minerals, especially malachite, chalcocite, and a little chalcopyrite. In one place minute white metallic veinlets thought to be stibnite or molybdenite are present.

The croppings of the lodes in general are not prominent but weather even with or below the surface of the adjoining country rock, with the result that most of the best exposures occur in the edges of washes or smaller channels of erosion. They are generally heavily stained red, brown, and black by hematite, limonite, and manganese, respectively.

The lodes are opened by shallow shafts from 4 to 7 feet in width, and in most places the mercury minerals extend interruptedly across the shaft. In Discovery shaft of the Rico mine the deposit was reported to average about 5 per cent quicksilver all the way across the 4-foot shaft.

The principal lodes are the Rico, Mercury, and Seal Rock, which lie about parallel with one another. The Rico is the westernmost; about 4,500 feet east of it is the Mercury, and 3,000 feet farther east is the Seal Rock.

MINES AND PROSPECTS.

MERCURY PROSPECT.

The Mercury prospect is on the wagon road that connects Agua Fria and Paradise valleys and crosses the range by way of the low pass north of Squaw Peak. The prospect is at the summit of the pass, at an elevation of about 1,430 feet, in a large embayment of the mountains on the east. The pass is low, open, nearly flat, and in large part covered with rock fragments of moderate size washed from the adjacent slopes.

The property comprises four claims, the Mercury, Vampire, Almaden, and Fraction. The principal opening is the Mercury shaft, near the center of the Mercury claim. (See fig. 9.)

The country rock is a light-gray quartz schist in which the schistosity is well developed. It is medium grained and contains besides quartz considerable sericite and chlorite, some orthoclase feldspar, and magnetite. The quartz is in very fine to medium-sized grains and includes glassy-appearing beads of birdseye form. The micas occur chiefly in the form of fibrous groups and slender foils.

The development at the time of visit consisted mainly of a shaft 6 by 10 feet in cross section sunk on the Mercury lode to a depth of 10 feet. The lode is said to extend horizontally for 4,000 feet or more but was not traced by the writer. The lode and the country rock trend about N. 30° E. and dip 70° E.

Besides the pronounced schistosity, which approximately parallels the lode, and a cross cleavage or fracturing, the lode and country rock are cut by a nearly horizontal sheeting into slices 6 inches to a foot in thickness. This facilitates development as the slices can be successively removed with ease.

The lode as exposed in the shaft is composed almost wholly of portions of the siliceous country rock, which has been greatly sheared and impregnated with minerals of quicksilver and of copper, principally cinnabar, metacinnabarite, and malachite. These minerals and hematite give to the ore a reddish and greenish, mottled and streaked

appearance. They occur chiefly as films and parallel veinlets thoroughly interlaminated in the schist, and in places the minerals themselves are considerably sheared. They occur also on the joint planes, cleavage planes, and other fractures. Some of the cinnabar exhibits good crystalline form. In general the films and veinlets of the quicksilver minerals are more or less distinct from those of the copper minerals, and in much of the rock the two classes alternate. Locally, however, the cinnabar and malachite are intimately associated in the same seam.

A fault plane accompanied by a 1 to 2 inch band of crushed schist or gougelike material is being followed down as the footwall. On the footwall side of this band, however, some cinnabar with its usual habit extends laterally into the adjoining wall rock for distances not yet determined. Similarly on the hanging-wall side of the shaft the quicksilver minerals extend laterally without interruption or decrease into the country rock with no indications of the hanging wall of the lode being near.

At the time of the writer's visit the shaft was about 10 feet deep and had found good showings of ore nearly all the way down, in the bottom, and extending across the shaft into both walls, especially the footwall. About the middle of April it was reported that the ore was improving with increasing depth. Late in June, according to report, the shaft had been sunk to the depth of 25 feet. At that depth the footwall is nearly vertical and the lode consists of 5 feet 2 inches of siliceous mercury ore of good grade, thus representing a widening in depth and an increase of quartz. The quartz is stained with malachite and contains hematite, a little cinnabar or cinnabarite, and a light-colored metamorphic mineral of radial habit, some of the crystals of which attain a length of three-fourths of an inch. The mineral has been identified as the silicate of aluminum, kyanite. In places the close association of the malachite stain with the hematite and the constancy in ratio of these two minerals suggest that they may have been both derived from cupriferous pyrite. Light on this and other questions may be expected with deeper development of the deposits.

The owners report about $5,000 worth of ore on the dump and estimate $20,000 worth more in sight in the ground. They were planning to treat the ore during the winter of 1917–18 in a reduction plant to be installed on their farm on the Paradise Valley slope three-fourths of a mile from the mine.

RICO PROSPECT.

The Rico prospect is on the lower west slope of the range, at an elevation of about 1,300 feet, on Mercury Wash, about 2 miles south-

west of the Mercury prospect and on the same road. The property comprises a group of eight claims known as the Rico group. (See fig. 9.) It has an extent of four claim lengths, or more than 1⅛ miles. Nearly all of it lies on low, open ground and is easy of access.

The country rock is a dense quartz schist, in which chlorite and magnetite are abundant. It is dark gray, with a reddish hue, and on the schistosity planes presents a satiny sheen.

The country rock and lode strike approximately N. 25° E. and dip 70° SE. The lode is about 80 feet in width and 6,000 feet or more in length. To judge from croppings it extends well up into the mountains that bound the pass on the north. It consists mainly of highly sheared and mineralized country rock and it contains considerable quartz in the form of veinlets and stringers, which are mostly parallel with the lode and some of which are 2 inches or more in width. The oxidized ore contains kyanite sparingly in groups of thin radiating crystals.

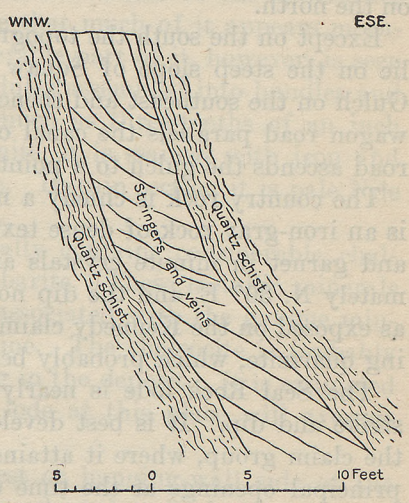

FIGURE 11.—Cross section of a part of the Rico lode, in the Phoenix Mountains quicksilver belt, Arizona, showing general attitude and relations of the principal quicksilver-bearing stringers and veins.

The quicksilver minerals are principally cinnabar and metacinnabarite. They occur both in the quartz and in the schist, but the schist seems to have been more easily replaced by the depositing solutions.

At the time of visit the deposit had been opened to a depth of 9 feet by three shafts situated in alinement on the lode within a distance of 42 feet. In the middle shaft, known as Discovery shaft, the deposit extended all the way across the shaft and was reported to average approximately 5 per cent in quicksilver. A crude five-retort plant had been installed, and 10 pounds of commercial quicksilver had been produced from a three days' trial run, the ore treated having been cobbed to a grade of about 30 per cent mercury.

In April the shaft had reached a depth of 22 feet. The ore was found to be continuous all the way down and to occur mostly in stringers dipping into the hanging wall, as shown in figure 11. Two flasks of quicksilver had been produced. By the end of August the shaft had been sunk to a depth of 60 feet, and a crosscut at this depth showed the principal part of the lode to be 7½ feet in width and to average 1 per cent or more in quicksilver. Here the ore contains

much metacinnabarite, which is said to carry considerable quicksilver, and to constitute good retort ore. Associated with the ore is considerable specularite.

SEAL ROCK PROSPECT.

The Seal Rock property in the southeastern part of the area comprises a group of six or more claims located along a lode which strikes a little east of north. (See fig. 9.) Claims 1, 2, 3, and 4 are being developed by E. L. Ish, to whom they are bonded and who is also the owner of claim 6 on the south and the Sherlock claim on the north.

Except on the south the topography is mostly rough. The claims lie on the steep slope of Squaw Peak that is drained into Squaw Gulch on the southeast and thence southward to the canal. A good wagon road parallels the canal on the south, from which a branch road ascends the gulch to a point nearly opposite Squaw Peak.

The country rock is chiefly a micaceous kyanite-quartz schist. It is an iron-gray rock of dense texture and locally contains magnetite and garnet in minute crystals and grains. The strike is approximately N. 30° E. and the dip normally 70° SE. On the southeast, as exposed on the Kennedy claim, this rock gives way to the overlying quartzite, which probably belongs to a younger geologic period.

The Seal Rock lode is nearly parallel to the inclosing schist in strike and dip. It is best developed in the northern two-thirds of the claim group, where it attains a width of 40 feet or more. The principal openings at the time of visit were the location openings made on claims 1 and 5.

The opening on claim 1 is on the upper southerly slope of Squaw Peak, at an elevation of approximately 1,640 feet, or about 100 feet above the floor of Squaw Gulch. It consists of a 20-foot open cut extending across the lode. The cut has a vertical face of 12 feet and together with neighboring croppings shows the country rock in this vicinity to be overturned, with the result that the dip of the inclosing rocks and lode is abnormal, being approximately 70° WNW., into the mountains. The overturn begins at a point nearly 200 feet south of the cut and extends for a considerable distance to the north of it on claim 2.

At this locality the lode, or at least the principal part of it, which is 8 feet in width, partakes largely of the nature of a vein, the walls being more or less well defined. It is composed almost wholly of a gangue of metamorphic minerals consisting chiefly of kyanite and tourmaline in the estimated ratio of 8 to 1.

The kyanite occurs in groups of bladed and columnar crystals of radiating habit. The larger groups are 5 or 6 inches in diameter. The individual crystals average nearly an inch in length, and some attain a length of 2 inches. In the deeper part of the cut, however, the crystals are shorter and the radiating or spherulitic structure is less pronounced than near the surface. In the pure state the crystals are whitish, but in the present deposit they are mostly heavily stained reddish or reddish brown and green by iron and copper. Some of the reddish stain is probably also due to cinnabar.

The tourmaline occurs largely as a dark-gray or blackish matrix filling the interstices between the bunches and spherulites of kyanite and forming also nodular nuclei at the centers of the spherulites and fans. It is so finely crystalline that much of it appears megascopically to be massive. A considerable part of it, however, is seen to consist of slender prisms and nodules assembled into bundles and radiated or fan-shaped groups as much as three-tenths of an inch in length or radius. Like the kyanite, it is stained with iron and malachite, but to a much less degree. In thin section it is pale Nile green.

The kyanite-tourmaline mass locally contains considerable chalcocite and some cinnabar and cinnabarite. These metallic minerals seem to be more or less intimately associated with the gangue minerals, particularly with the tourmaline. The chalcocite is probably the source of the malachite occurring in the deposit. It is estimated that a considerable portion of the lode at this place will average about 6 per cent in quicksilver.

The country rock on the northwest or hanging-wall side of the lode is the micaceous kyanite-quartz schist described above, except that much of it, as shown on the schistose planes, is composed of slender kyanite crystals lying parallel with the schistosity. The rock in this respect resembles an ordinary amphibolite or hornblende schist. The crystals are as much as three-tenths of an inch in length.

Microscopic examination of the rock shows it to be composed approximately of quartz 60 per cent, kyanite 30 per cent, mica and other minerals 10 per cent.

The rock on the southeast or footwall side of the lode is composed of quartz 30 per cent, kyanite 60 per cent, mica and other minerals 10 per cent. The kyanite occurs profusely in rosettes which lie in or parallel with the planes of schistosity. The crystals average half an inch in length, and the rosettes are accordingly nearly an inch in diameter.

Although the metamorphism seems to have been most intense along the zone of shearing now marked by the course of the lode, yet it extended laterally several hundred feet into the adjoining rocks. The lode itself consists chiefly of highly sheared rock which has

been metamorphosed beyond recognition and subsequently mineralized. The quartz existing in the rock prior to the metamorphism seems to have supplied the silica in the kyanite, a fact which may account for the meager development of quartz in the lode.

The location shaft of claim 5, which is about 4,000 feet from that of claim 1, on the northeast slope of Squaw Peak at an elevation of 1,850 feet, is 3 feet deep and extends 7 feet crosswise of the lode. Here the lode, to judge from the heavily stained croppings, has a width of 40 feet or more. The dip is normal, being approximately 70° WNW. The strike, however, follows a somewhat curved course, owing to the fact that at a point about 1,000 feet to the south, on the northern part of claim 3, a transverse fault has carried that part of the lode which adjoins it on the north several hundred feet eastward, approximately to the side line of the claim, and also partly to the fact that to the north of No. 5 opening the strike is N. 42° E., or 15° more to the east than in the southern part of the group.

The country rock is micaceous kyanite-quartz schist similar to that on the northwest or hanging-wall side of Discovery cut on claim 1, but more highly schistose and less laminated. By estimate based on examination of a thin section it is composed of quartz 50 per cent, kyanite 40 per cent, mica and other minerals 10 per cent. As shown in hand specimen much of the kyanite occurs as pinkish crystals or streaks and reddish-brown specks; the latter seem to represent cross sections of crystals. The kyanite is much more plentiful in the lode than in the rock, but neither kyanite nor tourmaline is so abundant as in the opening on claim 1. Approximately 30 per cent of the gangue consists of quartz, some of which occurs in grains that seem to be but little changed from their earlier form and condition in the country rock. The radiating habit of the kyanite so prevalent on claim 1 is not shown here in the wall rock and but slightly developed in the lode, the crystals being generally parallel to the schistosity.

So far as opened the lode is heavily stained reddish brown with iron and the quicksilver minerals cinnabar and cinnabarite, which occur in the planes of schistosity, cleavage, and sheeting. The rock also shows, particularly as a coating on certain of the schistosity planes, considerable whitish clay or kaolin. About 3 tons of ore lying on the dump is reported to average approximately 10 per cent in quicksilver.

JONES-HUSTED PROSPECT.

The deposits on the Jones-Husted group of claims were discovered and located by the owners, B. Jones and E. Husted, both of Phoenix, December 30, 1916. They are in the northwestern part of the area and are easy of access, being mostly on open ground about half a

mile south of the well-traveled Camp Creek road and southwest of the Montgomery post office. (See fig. 9.)

The country rock consists mainly of sericite schist and sericitic quartz schist with interbedded layers of slate and phyllite and layers or lenses of greenstone schist, ferruginous carbonate or limestone, hematite, and jasper. Magnetite in fine crystals or grains is common in much of the rock. The greenstone schist with which some of the deposits are intimately associated resembles graywacke in texture and consists mainly of a mixture of chlorite, quartz, calcite, orthoclase, sericite, carbonaceous material, and magnetite. The prospective deposits of this group are contained in three parallel lodes extending for nearly a mile. The lodes in places are well mineralized, but they have not yet been proved to contain quicksilver. The deepest opening is about 8 feet in depth.

BOULDER PROSPECT.

The Boulder prospect, in the southern part of the area, about a quarter of a mile west of Squaw Peak (see fig. 9), was discovered and staked by the owners, L. L. Brunson and Gus Alsted, February 21, 1917. A little cinnabar has been found here.

ORIGIN OF THE DEPOSITS.

The origin of the quicksilver deposits here described is not manifest. The genesis of quicksilver deposits in general is ascribed to volcanic activity or its after effects, such as circulating thermal solutions, hot springs, and fumaroles. The deposits in the Phoenix Mountains were probably formed by heated solutions or vapors which, ascending through the shear zones, penetrated the interstices of the rocks and deposited by processes of impregnation and replacement their mineral burden as veinlets, films, and stringers. As kyanite is a mineral known to form only under conditions of high temperature and pressure it is probable that the mercury was introduced long after the kyanite. Quicksilver deposits in general are not of the deep-zone class but occur at relatively shallow depths, mostly within 2,000 feet of the surface. The material available for study, however, does not afford conclusive evidence that the mercury minerals are younger than the kyanite and tourmaline.

As the deposits are believed to be later than most of the metamorphism and the formation of the dominant structure of the pre-Cambrian rocks, and as it seems most reasonable to consider that they are genetically connected with volcanic activity, they are provisionally referred to the Tertiary period, during which volcanism was general in the Southwest.

Volcanic or eruptive rocks with which the origin of the deposits may be connected were not observed in this area, but as only portions of the area were visited it is quite possible that such rocks may be present. The eastern slope of the large mountain about 2 miles northwest of the area and about the same distance west of Montgomery is composed of black rock which seen from a distance was regarded by the writer as probably basalt. The nearest volcanic rocks reported in the Phoenix Range are 7 miles to the north, near Cave Creek station, where there are several hills of vesicular basalt.[1] Andesite occurs 6 miles to the southeast, in the buttes north of Tempe.

FUTURE OF THE BELT.

From the present development of the deposits it is impossible to estimate their ore reserves. Three of the properties—the Mercury, Rico, and Seal Rock—have workable ore which averages 3 per cent or better in quicksilver and which, to judge from the persistence of the lodes, probably has considerable horizontal and lateral extent. Likewise, from the constancy or improvement of the ore in depth so far as the developments now extend it seems that the ore may be expected to continue to reasonable depths, especially in the oxidized zone.

From the accessibility of the deposits and their nearness to the railroad and camp supplies, it is probable that ore averaging as low as 1 per cent in quicksilver can be profitably worked with the metal at its present market price. Mr. Samuel Hughes, who is experienced in mining quicksilver in California, believes that ore containing only 0.5 per cent of the metal can be treated on the ground. In the Terlingua district, Tex., furnace ore of as low grade as 0.75 per cent quicksilver is said to be worked.

CORRELATION WITH OTHER DEPOSITS.

MAZATZAL MOUNTAINS.

In the eastern slope of the Phoenix Mountains the strike of the rocks and the lodes in the quicksilver area curves to approximately northeastward. The projection of this strike line extends through the quicksilver area of the Mazatzal Mountains, near Sunflower Camp and Pine Butte, 45 miles to the northeast, where also, according to Ransome,[2] the rocks and lodes have in general a northeastward strike. This approximate alinement in strike, together with similarities in geologic occurrence, suggests that the deposits in the two

[1] Meinzer, O. E., and Ellis, A. J., Ground water in Paradise Valley, Ariz.: U. S. Geol. Survey Water-Supply Paper 375, p. 55, 1915.

[2] Ransome, F. L., Quicksilver deposits of the Mazatzal Range, Ariz.: U. S. Geol. Survey Bull. 620, p. 117, 1915.

areas may be of the same origin and formed at the same time. In both areas the rocks are of the pre-Cambrian schist series, though in the Mazatzal area, according to Lee,[1] they are less altered than in the Phoenix area, and in both areas the lodes are persistent over the surface.

In the Phoenix area the rock zone on the northwest, in which the Jones-Husted group is located, seems to correspond closely with the principal mineral-bearing zone in the Mazatzal area described by Ransome[2] as the Maricopa County belt.

McDOWELL MOUNTAINS.

The occurrence of the Mazatzal and Phoenix deposits on the same line of strike by no means implies continuity of the deposits throughout the intervening distance. It may be worthy of note, however, that the line of strike connecting the two areas crosses the northern part of the intervening McDowell Mountains, which so far as known to the writer have not been prospected for quicksilver. This alinement, taken in connection with the fact that the McDowell Mountains are composed of rocks that are of the same classes and have the same general attitude as those in the Phoenix and Mazatzal areas, suggests that this part of the McDowell Mountains, separated from the Phoenix Mountains by Paradise Valley on the west and from the Mazatzal Mountains by the Verde River valley on the east, may be worthy of inexpensive prospecting.

The line of strike of what may possibly be a quicksilver belt should cross the McDowell Mountains about 4 miles southeast of the road between Phoenix and Camp Creek, or 12 miles from the Phoenix area. Accordingly, the more likely field in which to prospect in these mountains embraces an area extending from the vicinity of Pinnacle Mountain, 4 or 5 miles southeastward to Mountain Spring or McDowell Peak. Owing to the cover of valley fill on the east, the west slope of the mountains will doubtless be found the better exposed for prospecting, but the belt also includes Fraesfield Mountain and other hills on the northeast. The area is easily reached by the Mountain Spring road and several other wagon roads on the west, or by a road from Fort McDowell paralleling the range on the northeast. The Camelsback topographic sheet of the United States Geological Survey, which covers the area on a scale of 1 mile to the inch, with a contour interval of 50 feet, will be found helpful as a guide and in determining locations.

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[1] Lee, W. T., Underground waters of Salt River valley, Ariz.: U. S. Geol. Survey Water-Supply Paper 136, p. 96, 1905.

[2] Op. cit., p. 120.